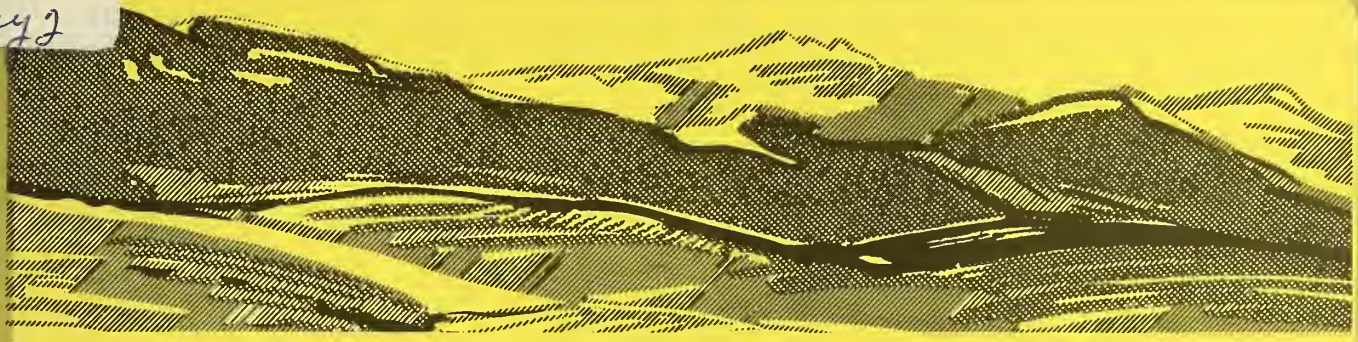


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RANGE IMPROVEMENT



JANUARY 1968

NOTES

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FOREST SERVICE — U. S. DEPARTMENT OF AGRICULTURE
INTERMOUNTAIN REGION — OGDEN, UTAH

CONTROL OF TALL LARKSPUR WITH HERBICIDE

By

Darrol T. Fluckiger*

Larkspur poisoning has always been a serious problem on the cattle ranges of the Targhee National Forest. As we intensify livestock management and use rotation systems of grazing, the larkspur causes even greater problems.

Since 1962 we have been working on the chemical control of tall larkspur with 2, 4, 5-T. We have been following the recommendations of Torrell and Higgins from the University of Idaho. (See Range Improvement Notes, January 1963, Vol. 8, No. 1.) They recommended the use of a low volatile ester of 2, 4, 5-T at the rate of 4 pounds acid equivalent in 50 gallons of water per acre.

We have had satisfactory results (80-90% kill) with this mixture on Delphinium occidentale if we treat the area two years in succession. A single treatment will only give a complete kill on about 10 percent of the plants and give abnormal growth and discoloration on about half of the remaining plants the first year. This treatment has not proven satisfactory on Delphinium stachydeum. A single application made at the time suggested by Mr. Higgins, who made an inspection of the area, resulted in a total kill of 5 percent or less. We sprayed this area again this spring which makes two years in succession. I am very doubtful that we will get even a 50 percent kill. The plants burn down within a few days after spraying but many of them start regrowth within one month.

In 1966 we treated an area of Delphinium stachydeum with Tordon at the rate of 1/2 pound active material per acre in 50 gallons of water. A University of Wyoming publication indicated that they had been able to control larkspur at this rate of application.

Results: In 15 days the plants showed abnormal growth characteristics. There was very distinct curling and twisting of the stems. Plant color was normal. After one month, growth was very erratic on most plants. The ends of the leaves were drying on some plants but most of the plants still contained moisture. Many of the plants had red and yellow coloration in the stems and leaves. The plants that were still green were an off-green color. Leaves of all plants were shiny. In two months the plants had dried up. A thorough check of the area was made the following summer and we could not find any live plants on the sprayed area.

*Range Staff - Targhee National Forest

Cost Comparison on Chemicals:

2, 4, 5-T - 4 lbs. acid equivalent - \$9.00 per gallon

Tordon - 2 lbs. active material - \$40.00 per gallon

2, 4, 5-T - one treatment - \$9.00 per acre

2, 4, 5-T - two treatments - \$18.00 per acre

Tordon - one treatment - \$10.00 per acre

Time to Spray:

The best time to spray tall larkspur is after all the shoots have emerged but before the flower stalk is evident. All of the spraying on Delphinium stachydeum was done at this stage of development.

* * * * *

Love of money is the root of half the evil in the world;

and lack of money is the root of the other half.

* * * * *

Keep your mind on the job - PREVENT ACCIDENTS.

WHEATGRASS ESTABLISHMENT
WITH PARAQUAT AND TILLAGE ON
DOWNY BROME RANGES 1/*

Raymond A. Evans, Richard E. Eckert, Jr., and Burgess L. Kay²/₁

INTRODUCTION

Large acreages of big sagebrush (Artemisia tridentata) land are being seeded to crested wheatgrass (Agropyron desertorum) and other perennial grasses in the western states. Establishment of these grasses is difficult in areas infested with downy brome (Bromus tectorum) and other annual weeds. Areas of previous seeding failures, wild fires, and where big sagebrush has been killed by insects or herbicides often are covered with downy brome and associated species. These plants offer severe competition for moisture, nutrients, and sometimes light, to seedlings of perennial grasses during establishment.

Seeding failures in areas infested with downy brome emphasize the need for better and more consistent weed control than from present methods during the crucial seedling stage of these perennial grasses.

Evaluations of 1, 1'-dimethyl-4, 4'-bipyridinium salt (paraquat) as a contact grass killer in combination spray and reseeding programs on pastures and rangelands have been made both in this country and abroad. This herbicide has fast contact action and it is rapidly deactivated in soil. These properties make paraquat well suited for weed control in a range seeding program since seeding can be done immediately following spraying. The study reported here was undertaken to evaluate paraquat, other herbicides, and mechanical treatments for herbaceous weed control and subsequent establishment of perennial grasses on big sagebrush rangelands infested with downy brome and broadleaf weeds.

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²/Research Range Scientists, Crops Research Division, Agricultural Research Service, U. S. Dept. of Agriculture, University of Nevada, Reno, Nevada, and Associate Specialist, Dept. of Agronomy, University of California, Davis, California.

*Taken from WEEDS - Vol. 15, No. 1, January 1967.

PROCEDURE

Trials were conducted 4 years (1962-1965) at one location (Likely, near Alturas) in northeastern California, and 3 years (1963-1965) at 4 locations (Medell Flat near Reno, Paradise Hill near Winnemucca, Italian Canyon near Austin, and Emigrant Pass near Elko) in central and northern Nevada. Four of the locations were areas of previous fires and one was an area of seeding failure. At time of study, all sites supported a dense cover of downy brome and broadleaf weeds. Broadleaf weeds found on various sites included tansy mustard (Descurainia pinnata), redstem filaree (Erodium cicutarium), tumble mustard (Sisymbrium altissimum) and Russian thistle (Salsola kali var. tenuifolia). Average annual precipitation on the study sites varied from 7.7 to 12.6 in. based on long-term records of weather stations in the near vicinity of each plot. Precipitation over the years of the experiment was generally comparable to or somewhat higher than the long-term averages on the study sites. Total annual (July 1 to June 30) and March through May precipitation records are presented in Figure 1.

Soils vary from Aridisols on the drier sites to Mollisols on the more moist sites.

Table 1 summarizes the weed control and seeding variables examined in this study and tabulates the comparisons made among these variables at different locations and in different years.

Paraquat was sprayed as an overall application at rates ranging from 2.0 to 0.04 lb. /A with dates of spraying varying from February 25 to May 1. Paraquat was sprayed in bands of 4, 6, 8, and 12 in. centered on the drill rows at 1.0 lb. /A. Paraquat also was applied at different rates with 0.5 lb. /A of 2,4-D. Paraquat was sprayed in the morning and afternoon in the 1962 experiment at Likely.

Other herbicides were sprayed as overall applications and included diquat at 6.0 to 0.1 lb. /A; isocil at 4.0 to 0.06 lb. /A; cacodylic acid at 8.0 to 0.06 lb. /A; pyriclor at 1.0 to 0.12 lb. /A; 2,4-D at 4.0 to 0.06 lb. /A, (dalapon) at 6.0 to 0.06 lb. /A, and herbicidal oil at 100 to 12.5%. Application dates were from March 29 to April 20.

All herbicides were sprayed logarithmically and were applied in water at 65 gpa and 30 psi. The surfactant X-77^{3/} at 0.06 and 0.1% v/v was used with spray solutions.

^{3/} X-77 is a trademarked surfactant containing alkylaryl polyoxyethylene glycols, free fatty acids, and isopropanol supplied for this experiment by Colloidal Products Co. and Ortho Division, Chevron Chemical Co.

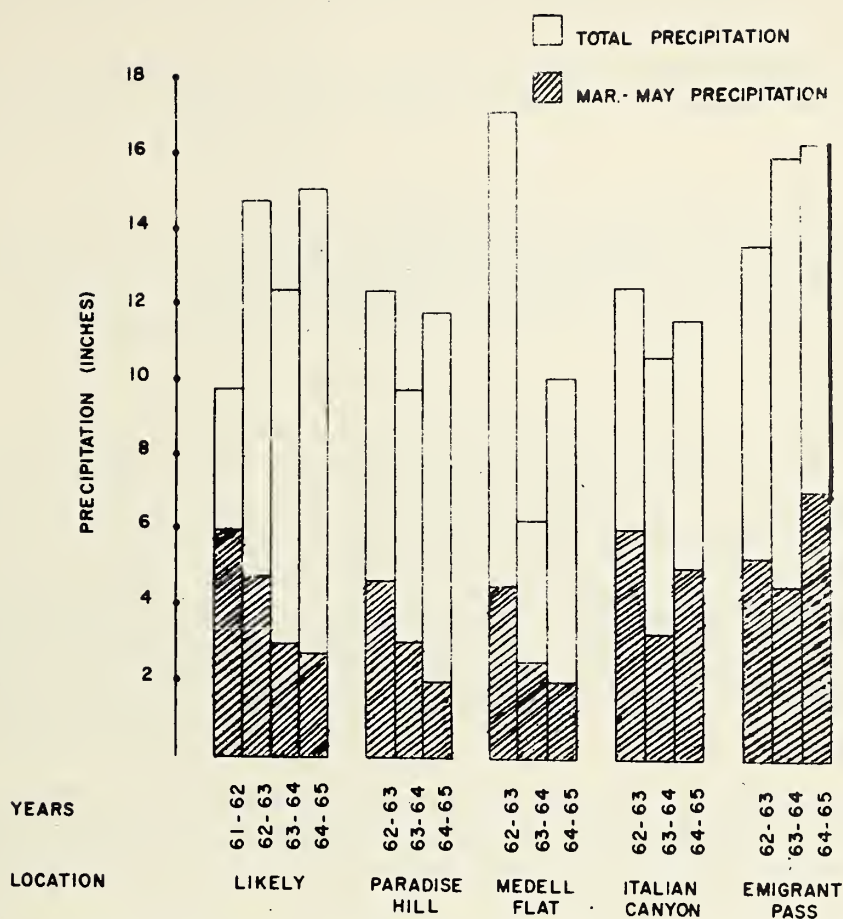


Figure 1. Total(July 1 to June 30) and March through May precipitation for each year at all locations during the study.

Table 1. Comparisons made among weed control and seeding variables in experiments by year and location in this study.

Weed control and seeding comparisons	Location and years															
	Likely				Paradise Hill			Medell Flat			Italian Canyon			Emigrant Pass		
	62	63	64	65	63	64	65	63	64	65	63	64	65	63	64	65
ates of paraquat vs. check.....	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
araquat vs. disked and furrowed treatments..	X		X	X	X	X	X		X	X		X	X		X	X
araquat vs. other postemergence herbicides...	X			X												X
ifferent dates of spraying and seeding at each location.....		X		X	X	X		X				X				
and vs. overall spraying.....		X	X	X		X		X	X			X			X	
araquat with and without 2,4-D.....			X	X		X			X			X			X	X

Perennial grasses were seeded either immediately before or after paraquat spraying in two experiments in 1963. In all other trials, seeding was done immediately after spraying paraquat and other herbicides.

Other treatments seeded with perennial grasses were undisturbed, disked, furrows in undisturbed plots, furrows in disked plots, and furrows in paraquat plus 2,4-D plots.

Amur intermediate wheatgrass (Agropyron intermedium) and Standard crested wheatgrass (A. desertorum) were seeded in all Nevada trials. Amur and Greenar intermediate wheatgrasses, Topar pubescent wheatgrass (A. trichophorum) and Standard crested wheatgrass were seeded at Likely.

Crested wheatgrass seeds were drilled 1/2 to 3/4 in. below the soil surface. Seeds of the other wheatgrasses were drilled 3/4 to 1 in. deep. All grasses were planted at the rate of 2 seeds per in. Different drills were used in the experiments with either shank or offset disk openers. Shank openers made a slit about 1/2 in. wide and 2 to 3 in. deep. The offset disk openers made a small furrow varying in depth from 1 to 3 in. depending on soil conditions. Furrows, 4 to 6 in. deep and 4 in. across at the bottom and 10 to 12 in. at the top, were made with shovels attached in front of the drill.

Design of all field trials involving logarithmic spraying of herbicides was a four-replicated split-plot with systematic arrangement of subplots. Individual plot size was 6 to 8 ft. wide and 100 to 150 ft. long.

Weed control was visually evaluated through the growing season on all plots. Ovendry yields of the mature weeds were used to evaluate season-long control. Downy brome was clipped near the end of June and broad-leaf weeds were clipped in July or August.

Stand establishment of perennial grasses was evaluated by first-year seedling counts and height measurements made in late July after annual plants had dried. In some instances, perennial grass seedlings were counted several times during the growing season to study time of moisture stress and mortality of seedlings.

Yield, and in some cases frequency, of perennial grasses was taken in successive years to further evaluate stand establishment, vigor, and productivity.

RESULTS AND DISCUSSION

Weed Control Yield of downy brome with no weed control averaged 100 lb. /A about 2 weeks after spraying and 1,000 lb. /A at maturity (Figure 2). When

sprayed with paraquat at 0.5 and 1.0 lb. /A, downy brome was virtually eliminated 2 weeks after spraying and season-long growth was reduced to 300 and 200 lb. /A respectively. Regrowth of downy brome plants, initially desiccated but not completely killed by paraquat, and growth of plants germinated after spraying resulted in a more weedy seedbed later in the growing period. The weediness of the seedbed was increased by late spring rains.

Downy brome plants were partially desiccated and some measure of control was seen from paraquat at rates as low as 0.06 lb. /A. Clean initial control of downy brome was attained by an average minimum rate of 0.46 lb. /A of paraquat. On individual trials, the minimum rate of paraquat for satisfactory initial weed control varied from 0.12 to 1.0 lb. /A.

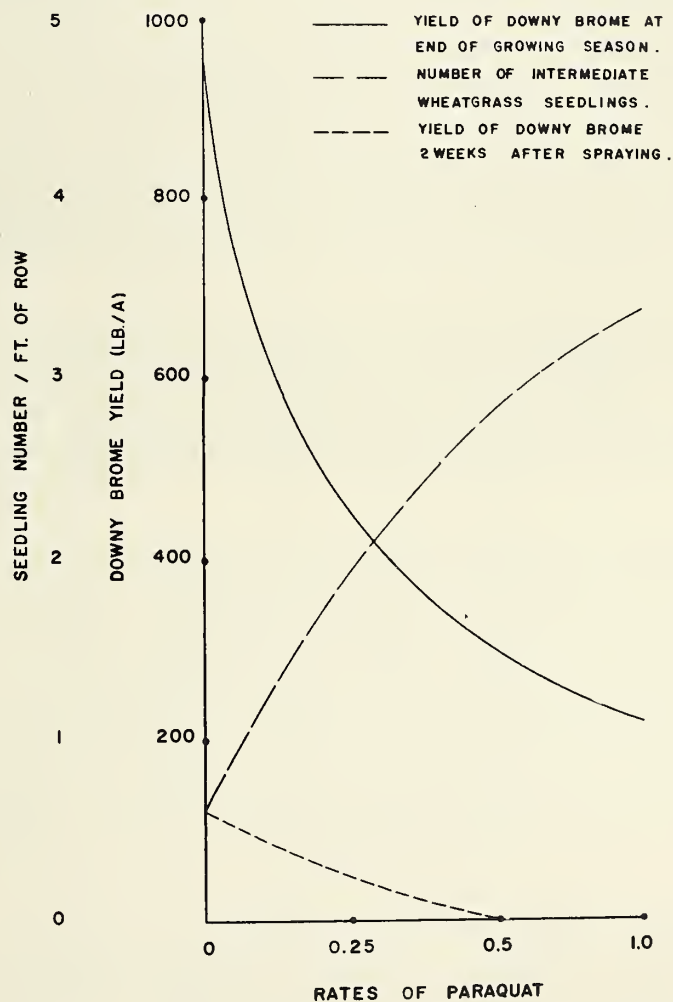


Figure 2. Mean first-year downy brome yields and numbers of intermediate wheatgrass seedlings at all locations for 3 years of the study (1963-1965).

Differences in effectiveness of paraquat for weed control among trials were generally explainable in terms of conditions at time of spraying or immediately thereafter (e. g. , time of spraying relative to the percentage emergence of the stand or phenological development of individual plants, temperature when spraying, or drought conditions after spraying). In 1963, 0.75 lb. /A of paraquat was necessary for satisfactory control of two trials. On one trial, plots were sprayed at 33°F. with snow falling. On the other, paraquat was sprayed May 1 when downy brome plants were large. In 1964, poor weed control from paraquat was seen at one location, not because of lack of initial kill but because a long period of drought followed spraying. This dry period at the beginning of the growing season almost eliminated the first crops of downy brome whether sprayed or not. Downy brome, which emerged later in the spring, partially occupied the bared area resulting in little differences between sprayed and unsprayed plots.

Spraying before seeding gave better weed control than spraying after seeding. Downy brome plants, or at least parts of individual plants, were covered by soil in the drilling operation and escaped the spray. Consequently, drill rows became infested with weeds, even at high rates of paraquat. Also, recent data indicate that as little as 0.25 lb. /A of paraquat will drastically reduce viability of grass seeds.^{4/} Thus, not only does lack of weed control decrease seedling stands, but also the hazard exists of killing perennial grass seeds not completely covered in the drilling process.

Afternoon application of paraquat controlled downy brome somewhat better than morning application, especially at rates of 0.36 l. b/A and less (Table 2). Time of spraying comparisons were made in only one trial because practicability of late afternoon spraying is questionable in any large scale operation.

Control of broadleaf species accompanying downy brome presented a somewhat complex problem. Paraquat alone controlled tansy mustard and redstem filaree. Tumble mustard was not controlled by paraquat but the addition of 2, 4-D to paraquat gave good control of this species (Table 3). Russian thistle was not controlled by the paraquat-2, 4-D mixture and this species occupied the plots bared by herbicide later in the year. Lack of Russian thistle control occurred because these plants emerged after spraying. A later spraying of 2, 4-D at 1 lb. /A was sufficient to control Russian thistle in the bared paraquat plots.

Disking or similar mechanical treatment in most cases controlled weeds as well as spraying paraquat (Tables 2 and 3). In some trials, more late growth of weeds occurred on disked plots. In others, the seedbed became more weedy with paraquat. This relation depended on initial weed control and availability of germinable seeds resulting from the respective treatments.

^{4/} Kay, B. L., Unpublished data.

Table 2. Downy brome control, seedling counts and yields of Topar pubescent wheatgrass with respect to treatments in the 1962 trial at Likely.

Treatment	lb/A	First year (1962)		Yield of wheatgrass ^c		
		Downy brome control ^a	Number of seedlings ^b	Second year (1963)	Third year (1964)	Fourth year (1965)
Paraquat (Applied in afternoon)	1.4	10	7.1	1070a	890ab	850ab
	0.7	10	6.5	780bc	750bc	670bc
	0.36	10	4.8	450de	530cde	680bc
	0.18	5	2.9	200ef	420dcf	500cd
	0.09	5	1.4	90f	200fg	480cd
	0.04	0	0.8	30f	180fg	180e
Paraquat (Applied in morning)	1.4	10	7.6	530cd	830abc	840ab
	0.7	10	6.3	530cd	790bc	820b
	0.36	5	2.3	190f	340efg	610bc
	0.18	5	2.2	50f	190fg	380de
	0.09	0	0.2	10f	50g	140e
	0.04	0	0	10f	10g	10e
Rototilled		10	7.4	940ab	1100a	1080a
Check		0	1.2	30f	100fg	190e

^aWeed control rating from 0 (none) to 10 (excellent).

^bNumber of seedlings per foot of row.

^cYield in lb/A oven-dry forage. Means within each year followed by the same letters are not significantly different at the 5% probability level as determined by Duncan's Range Test.

Table 3. Downy brome and mustard yields and seedling counts and yields of wheatgrasses in response to treatments at Paradise Hill, 1964.

Treatment ^b	lb/A ^c	First year (1964)				Second year (1965)	
		Downy brome yield lb/A	Mustard yield lb/A	Seedling numbers ^a		Yield lb/A	
				Intermediate wheatgrass	Crested wheatgrass	Intermediate wheatgrass ^d	Crested wheatgrass
Paraquat + 2,4-D (early)	2.0	280	0	2.1	0.6	600a	30
	1.0	480	0	1.6	0.6	380a-d	70
	0.5	520	0	2.0	0.1	380a-d	20
	0.25	509	0	0.8	0.2	140cde	20
Paraquat + 2,4-D (late)	2.0	220	0	1.5	0	550ab	5
	1.0	210	0	1.2	0.4	480abc	70
	0.5	330	0	1.2	0.2	220b-c	40
Paraquat (early)	2.0	140	210	1.1	1.0	230bc	30
	1.0	270	840	1.4	0.8	180cde	10
	0.5	300	300	1.5	1.0	110cde	10
	0.25	370	510	0.5	0.6	40de	5
Paraquat (late)	2.0	350	140	0.8	0	20de	10
	1.0	410	110	0	0	80de	5
	0.5	520	320	1.4	0.2	140cde	10
	0.25	410	120	0.1	0	20de	0
Disked (early) (late)		350	0	1.3	0.2	370a-d	60
		170	0	1.0	1.0	460abc	40
Check (early) (late)		1160	360	0	0.1	5e	0
				0	0	1e	0

^aNumber of seedlings per foot of row.

^bEarly date of spraying and seeding was March 11, 1964; late date was April 7, 1964.

^cRates of paraquat expressed in lb/A; 2,4-D was applied at a constant 0.5 lb/A in paraquat-2,4-D mixtures.

^dMeans followed by the same letters are not significantly different at the 10% probability level as determined by Duncan's Range Test.

Establishment and production of perennial grasses. The beneficial effects of weed control by paraquat or by tillage in establishing wheat-grasses can be seen in initial seedling counts and subsequent production of perennial grasses (Tables 2, 3, and 4).

Recent investigations have indicated that activity of paraquat persists in some sand and sandy loam soils, especially when applied at extremely high rates (16 and 28 lb. /A). At the low rates of paraquat used and on the soils encountered in experiments reported, growth of wheatgrass seedlings did not suggest any persistent activity of this herbicide. In no case were perennial grass seedlings injured by paraquat when seeded immediately after spraying.

Large differences in initial weed control, as obtained with the high and low rates of paraquat, continued to be a major factor in the vigor and productivity of perennial grass stands through the fourth year. Stands from check plots were very weak and commonly were complete failures. Stands established by tilling usually were as productive in the second, third, and fourth years after seeding as were those sprayed by paraquat at 0.5 lb. /A or more.

Degrees of weed control derived from different rates of paraquat, especially those which gave fair to good control, had less influence on productivity of the stands as they became older and better established. Second-year yields were most strongly influenced by completeness of weed control, but differences measured in the preceding years were less marked by the third and fourth years.

Date of spraying and seeding was an important factor in success of perennial grass stands in some instances and in vigor of the plants established in others. Seeding failures resulted where spraying and seeding were done in late April or in May. Vigor of seeded stands usually was greater with early spraying and seeding; however, when this operation was done between the last of February and the first part of April, somewhat comparable stands resulted (Table 3). Larger, more vigorous seedlings and better survival from earlier plantings probably resulted from a longer growing season and deeper root penetration before summer drought. Vigor of perennial grass stands established from afternoon spraying was greater than those of morning spraying of paraquat at 0.36 to 1.4 lb. /A, as reflected in second-year yields (Table 2). Third and fourth year yields were not different as the result of time of spraying.

Comparable seedling establishment resulted from disking or paraquat spraying on most trials. Differences in stand resulting from a softer seedbed of the disk operation, compared to the nontillage paraquat spray



Table 4. Downy brome yields, and seedling counts and yields of Greenar intermediate wheatgrass, in response to treatments in the 1963 trial at Likely.

Treatments	lb/A	First year 1963		Second year	Third year
		Downy brome yield lb/A ^a	Number of seedlings ^{ab}	1964 lb/A ^a	1965 lb/A ^a
Paraquat.....	1.0	40a	5.2ab	260a	660a
	0.5	90a	5.4ab	210a	620a
	0.25	240a	8.4a	180a	590a
	0.12	240a	5.8ab	120ab	550a
	0.06	440a	4.4b	20b	110b
Check.....		1160b	1.3c	0b	0b

^aMeans followed by the same letters are not significantly different at the 5% probability level as determined by Duncan's Range Test.

^bNumber of seedlings of intermediate wheatgrass per foot of row.

Table 5. Downy brome yields, and seedling counts and yields of Amur intermediate and Standard crested wheatgrass at Italian Canyon, Spring, 1964.

Treatments ^a	First year (1964)			Second year (1965)	
	Downy brome yield lb/A	Seedling numbers ^b		Yield lb/A	
		Inter-mediate	Crested	Inter-mediate	Crested
Paraquat + 2,4-D					
Drill.....	560	2.6	0.6	200	60
Furrow.....	221	5.0	1.5	420	230
Disked					
Drill.....	50	6.0	1.9	240	120
Furrow.....	20	7.4	2.3	350	290
Check					
Drill.....	770	0.7	0.1	0	0
Furrow.....	500	4.7	1.6	270	60

^aTreatments were applied and plots were seeded April 15, 1964. Paraquat was applied at 1.0 lb/A and 2,4-D at 0.5 lb/A.

^bNumber of seedlings per foot of row.

Table 6. Seedling counts and heights, and yields of Greenar intermediate wheatgrass seeded in various width bands of paraquat, full coverage of paraquat, and in unsprayed plots at Likely, 1963.

Treatments	First year (1963)		Second year	Third year
	Numbers of seedlings ^a	Heights of seedlings ^b	(1964) yield lb/A	(1965) yield lb/A
Paraquat bands				
4 in.....	2.4	2.7	2	0
6 in.....	4.6	3.7	10	40
8 in.....	6.3	4.3	80	170
Paraquat full coverage.....	5.2	6.0	260	660
Check.....	1.9	2.6	0	0

^aNumber of seedlings per foot of row.

^bHeights of seedlings in inches.

operation were not readily apparent in this study. However, in some cases where seeding is done in very light soil, or when seeding a species more sensitive to depth of planting than the wheatgrasses, disking might well be disadvantageous.

Differences in establishment and productivity of seeded species were quite striking. Standard crested wheatgrass, the species ordinarily used for revegetation in the sagebrush type, did not show as much promise in these trials as did the other wheatgrasses tested. Amur and Greenar intermediate wheatgrasses and Topar pubescent wheatgrass exhibited good establishment, strong seedling vigor, and second-year yields of 200 to 1000 lb. /A. Three to 10-fold differences in second-year yield between Standard crested and Amur intermediate wheatgrass were recorded in the same trials. In most cases, stands of Standard crested wheatgrass were much poorer than the other grasses tested (Table 3). Apparently, crested wheatgrass does not have the seedling vigor to perform well in spring seeding. The other wheatgrasses tested have larger seeds, more storage in the seed, and more seedling vigor than does crested wheatgrass.

Severe competition of downy brome and associated broadleaf weeds was reflected in the mortality of perennial grass seedlings through the growing season. At one location in 1963, intermediate wheatgrass seedlings decreased from 5.5 per foot of row in the unsprayed plots in May to 2.0 in June and 1.0 in July. Where paraquat was sprayed at 0.5 lb. /A, seedling numbers remained constant at about 6.5 per foot of row at all three sampling dates. At higher rates of paraquat, seedling numbers decreased in July, probably because of the heavy late infestation of mustard resulting from the more complete control of downy brome. Crested wheatgrass seedlings exhibited a similar trend through the growing season but with fewer seedlings in all cases.

More consistent establishment of perennial grasses resulted by making a groove with a shank opener or small furrow with an offset-disk opener in combination with good weed control, than when seed was drilled into the surface soil. Seeding in the bottom of these depressions provided a more favorable microenvironment for the growth of seedlings and, thus, enhanced the chances for successful seeding.

Drilling into deep furrows made with furrowing-out shovels resulted in better stands than did surface drilling without prior weed control (Table 5). At most locations, these stands were not as vigorous as ones established by paraquat spraying or disking. Combining weed control from paraquat or disking with furrowing increased seeding success.

Effects of site and year. Promising results were consistently obtained on some sites, while success on other sites was more variable in both nontillage seeding using paraquat for weed control and with tillage.

Differences among soils was an important site variable affecting productivity of seeded stands and to a lesser extent seedling establishment.

The soil at Emigrant Pass is classified as an Entic Haplic Durustoll with an effective depth for roots of 24 in. At Likely, the soil is a Typic Durustoll with an 18-in. depth. Both of these soils are classified as Mollisols with an estimated mean precipitation of 11 in. or more. The soil at Paradise Hill is a Duric Mollic Camborthid with an effective depth for roots of 60 in. At Italian Canyon and Medell Flat, the soils are Mollic Haplargids with 60-in. depths. Soils at these three sites are classified as Aridisols, with an estimated mean precipitation of less than 11 in.

Considering the climatic-edaphic relations involved in this soil classification, the two Mollisols should support the best stands of perennial grasses and be the most productive. Amount and distribution of precipitation in the seeding year on any of these sites would tend to alter the effect of these relations in terms of seedling establishment. Also, amount of competing vegetation to be controlled differs among locations. For example, at Emigrant Pass, where the soil is a Mollisol, production of downy brome and other weeds was consistently higher than on other sites and has been over 4000 lb. /A dry matter in some years. Consequently, success in establishing perennial grasses using any method of weed control and seeding has been minimal at this location even though the site potential is high.

At Likely, less vigorous but more typical growth of downy brome and other weeds was encountered. Seedling establishment was better and production of seeded stands was consistently higher than on sites with Aridisol soils.

In general, successful establishment of wheatgrass by either spring paraquat spraying or spring disking in the big sagebrush community will be limited to years of near-normal or above-normal March through May precipitation. The over-riding limiting factor is lack of adequate moisture to establish these perennial grasses consistently. The two practices discussed here - weed control to reduce competition of annual species, and seeding method involving a type of furrowing - have greatly enhanced seeding success in favorable years and quite probably will extend successful seeding into drier years than could be expected by present methods.



But with any method of weed control and seeding, success of seedling establishment is very dependent on spring precipitation. For example, the best stands were established at Likely in years of highest March through May precipitation (1962 and 1963) (Figure 1). In 1964 and 1965, when rainfall was 3 in. or less during this period, success of seeding was marginal. This relation existed at all locations of the study but was not quite as apparent because of fewer years of testing.

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Hear no evil - See no evil - Speak no evil -
and you'll never be a success at a party.

* * * * *

A pessimist complains about the noise when opportunity knocks.

* * * * *

A banker gave his analysis of time -
YESTERDAY is a cancelled check
TOMORROW is a promisory note
TODAY is ready cash - SPEND IT WISELY.





